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ESCAP II: Estimation of Correlation Bias in 2000 A.C.E. Estimates Using Revised Demographic Analysis Results

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EXECUTIVE SUMMARY

This report presents new estimates of correlation bias in the 2000 A.C.E. Dual System Estimates (DSEs) using two sets of revised Demographic Analysis (DA) population estimates. The results show estimates of significant correlation bias in DSEs for adult Black males, and small estimates of correlation bias for Nonblack males 30-49 and 50 and over. DA and A.C.E. estimates for Nonblacks 18-29 are inconsistent in a way that precludes using the results to estimate correlation bias for Nonblack males 18-29 (and so zero correlation bias was assumed for this group.)

Previous correlation bias estimates given in Bell (2001) were based on comparison of 2000 A.C.E. estimates against DA estimates as of February 16, 2001. These original estimates are also presented here and the changes from the original estimates to the revised estimates are discussed. The revised DA estimates yield small changes to the original correlation bias estimates for adult Black males and Nonblack males 30-49 and 50 and over. For Nonblack males and females 18-29 the original DA estimates were quite inconsistent with the A.C.E. estimates. The revised DA estimates significantly reduced this inconsistency, but not quite enough to permit estimation of correlation bias for Nonblack males 18-29.

Correlation bias in DSEs results from failure of a general independence assumption underlying DSEs due to either (1) *causal dependence* – the act of being included in the census makes someone more likely or less likely to be included in the A.C.E., or (2) *heterogeneity* – census and A.C.E. inclusion probabilities vary over persons within post-strata. Correlation bias is generally expected to be negative, implying underestimation by DSEs (apart from other possible biases in the DSEs).

In fact, evidence of correlation bias in A.C.E. estimates comes from comparing them against population estimates from Demographic Analysis. Since DA estimates are limited to the national level for age-sex-race groups (Black versus Nonblack race), DSEs are aggregated to this level for comparisons. Some modifications are made to the DA estimates (including subtracting out the group quarters population) to make them comparable to the A.C.E. universe. Comparisons of the modified DA population totals against A.C.E. estimates provide a crude check on correlation bias because of the relatively large uncertainty about DA totals (due to errors in estimates of emigration and unauthorized immigration), and because of possible biases in the A.C.E. estimates. A.C.E. and DA sex ratios (number of males over number of females) provide more reliable comparisons. DA sex ratios can be combined with A.C.E. data to estimate correlation bias in DSEs for adult males assuming negligible correlation bias in DSEs for adult females. A variety of models are used for this purpose leading to alternative estimates of correlation bias for (adult male) poststrata, though all agree with the national DA sex ratios for age-race groups.

Three alternative versions of the DA estimates are compared to the 2000 A.C.E. results here:

- DA estimates as of 2/16/2001, also known as “Base DA,” documented in Robinson (2001a). These were used to produce initial estimates of correlation bias documented in Bell (2001).

- “Alt DA” estimates that assume double the number of unauthorized immigrants of the 2/16/01 DA estimates. These were also documented in Robinson (2001a).
- A revised set of DA estimates as of 9/18/2001 (“Revised DA”), documented in Robinson (2001b). These estimates assumed a 15 percent undercount rate for unauthorized immigrants.

The previous comparisons of the DA 2/16/01 estimates (totals and sex ratios) against the 2000 A.C.E. estimates revealed the following:

- The DA 2/16/01 totals were *lower* than the A.C.E. totals for many of the age-race-sex groups. The difference was particularly large for Nonblack males and females 18-29 (-8.4 percent and -5.8 percent, respectively.) These results are hard to explain in terms of “correlation bias.” In fact, comparisons of DA 2/16/01 and A.C.E. sex ratios for Nonblacks 18-29 are suspect given these results.
- DA 2/16/01 sex ratios for adult Blacks significantly exceeded those for A.C.E., leading to estimates of significant correlation bias in DSEs for adult Black males. The DA sex ratios for Nonblacks 30-49 and 50 and over slightly exceeded those from A.C.E. leading to estimates of small amounts of correlation bias.
- These estimates of correlation bias in the 2000 A.C.E. were broadly similar to estimates that were obtained for the 1990 PES. They were very close for Black males 18-29 and 30-49, with some differences in magnitude for the other adult males. The one exception was Nonblack males 18-29, which, in 1990, showed a small estimate of negative correlation bias. This contrasted with the problems noted above for this group in 2000, which prevented estimating correlation bias for this group.

Correlation bias estimates obtained with the “Alt DA” and DA 9/18/01 estimates showed mostly small changes from those obtained with the original DA (2/16/01) estimates:

- Correlation bias estimates for adult Black males and Nonblack males 30-49 and 50 and over showed fairly small changes from those obtained using the DA 2/16/01 estimates.
- For Nonblacks 18-29 the Alt DA and DA 9/18/01 estimates significantly reduced the differences between the DA and A.C.E. estimates. The difference between the levels of the DA and A.C.E. estimates shrank by about one-half, and the difference between the DA and A.C.E. sex ratio shrank even more dramatically. However, the A.C.E. sex ratio remained slightly higher (1.048 for A.C.E. versus 1.044 for DA 9/18/01), which would have still yielded a slightly positive estimate of correlation bias for Nonblack males 18-29. Thus, it was again decided not to estimate correlation bias for this group. We again proceeded with the assumption of no correlation bias for Nonblack males 18-29 on the grounds that
 - the 2000 estimates of relative correlation bias for older Nonblack males are small, and
 - the 1990 estimate of relative correlation bias for Nonblack males 18-29 was small.

1. BACKGROUND

Dual system estimates (DSEs) are said to contain bias if they systematically underestimate or overestimate the true population. *Correlation bias* in DSEs results from failure of an underlying independence assumption due to either (1) *causal dependence* – the act of being included in the census makes someone more likely or less likely to be included in the A.C.E., or (2) *heterogeneity* – census and A.C.E. inclusion probabilities vary over persons within post-strata. DSEs are in fact constructed within post-strata to minimize heterogeneity in the inclusion probabilities. When heterogeneity exists it is generally suspected to be of the form where persons missed in the census are more likely (than those found in the census) to also be missed in the coverage survey (A.C.E.). Correlation bias resulting from this form of heterogeneity is negative, implying a tendency towards underestimation. While the direction of the effect of causal dependence, if it exists, is less certain, the general concern about correlation bias in DSEs is the possibility of underestimation. For further general discussion of correlation bias, see Griffin (2000).

Biases in the sample estimates of the components of the DSE formula can also lead to biases in the DSEs, as discussed in Mulry (1991) and Mulry and Spencer (1991,1993). The net effect of these other biases and correlation bias could be positive or negative leading to over- or underestimation. Ideally, the DSEs, or the underlying data used to construct the DSEs, should be adjusted for other biases before estimating correlation bias, a point made by Wachter and Freedman (1999). This issue is discussed further in Bell (2001).

The primary approach to detection and estimation of correlation bias in DSEs in the context of the U.S. census has been to compare them to estimates from *demographic analysis* (DA). (For some discussion of other approaches see Bell (2001).) As discussed by Robinson et al. (1993), DA has the advantage that its estimates are constructed from administrative data sources some of which (birth and death registration data) are generally believed to be quite accurate. Comparison of DSE results against DA estimates provides an aggregate check for correlation bias whether due to causal dependence or heterogeneity (with some qualifications regarding allowance for other biases, as noted above).

DA estimates are subject to certain errors and limitations. Errors in the administrative data used for DA, particularly uncertainty about the level of unauthorized immigration to the U.S. and uncertainty about the level of emigration from the U.S., lead to errors in the DA estimates. For this reason, DA population estimates (DA totals) are thought to be relatively less accurate than DA *sex ratios* (number of males over number of females). This reflects an assumption that errors in migration estimates are not grossly different for males than for females.

DA estimates are also limited by a lack of detail. Difficulties in using administrative data to construct estimates of subnational migration mean that subnational DA estimates, while providing useful indicators, are of significantly lesser accuracy than DA national estimates. Also, limited racial detail in the administrative data sources, along with differences in racial classification from the census, limits separate DA estimates by race to simply Black and

Nonblack. This limitation is somewhat more pronounced in 2000 than in 1990 because the allowance of multiple race responses to the 2000 census creates some uncertainty about appropriate definitions of the Black and Nonblack groups for comparability of DA and A.C.E. results. This is discussed in Section 2. This limitation has small but appreciable effects on DA totals, but effects on DA sex ratios are negligible.

Because of the limitations of DA, to investigate possible correlation bias in DSEs from the 2000 A.C.E. we only use DA data at the national level broken down by age (four A.C.E. age groups), race (Black and Nonblack groups), and sex. DA totals provide rather crude checks on possible correlation bias separately for males and females, and also for all children 0-17. We use DA sex ratios to explore in more detail possible correlation bias for adult males assuming no correlation bias for adult females.

The primary purpose of this report is to present and compare estimates of correlation bias in 2000 A.C.E. estimates obtained using three alternative sets of DA estimates:

- DA estimates as of 2/16/2001, also known as “Base DA,” documented in Robinson (2001a). These were used to produce initial estimates of correlation bias documented in Bell (2001).
- “Alt DA” estimates that assume double the number of unauthorized immigrants of the 2/16/01 DA estimates. These were also documented in Robinson (2001a).
- A revised set of DA estimates as of 9/18/2001 (“Revised DA”), documented in Robinson (2001b). These estimates changed assumptions about several of the DA components and assumed a 15 percent undercount rate for unauthorized immigrants.

Section 2 of this report discusses how DA estimates can be modified to make them comparable to A.C.E. estimates for the purpose of assessing correlation bias. Section 3 then compares the modified DA estimates (three alternative sets) with the 2000 A.C.E. estimates in terms of population totals and sex ratios. Section 4 combines the DA sex ratios with the A.C.E. estimates to produce explicit estimates of correlation bias in the DSEs. Sections 3 and 4 include, both in summary discussion and detailed tables, the results obtained in Bell (2001) using the 2/16/2001 DA estimates. This is for comparison to the new results presented in these sections that were obtained using the other two DA alternatives. Corresponding results for the 1990 PES (Bell 1993,2001) are also provided for comparison. Section 5 discusses some additional work planned or in progress on estimating correlation bias in the 2000 A.C.E. estimates. Finally, the appendices to this report document the DA and related census data used here, and the detailed estimation results.

2. MODIFYING DEMOGRAPHIC ANALYSIS ESTIMATES FOR COMPARABILITY WITH A.C.E. ESTIMATES

Definitional differences between DA and A.C.E. estimates require adjustments to the data to make the two sets of estimates comparable. Since we wish to assess possible correlation bias in the A.C.E. DSEs, we make comparability adjustments to the 2000 DA estimates, not the other way around.

The first adjustment is to subtract the implied DA estimates of Black Hispanics from the DA totals for Blacks and add these same estimates to the DA totals for Nonblacks. This adjustment is needed because A.C.E. assigns Black Hispanics to its Hispanic race domain (domain 3), not its Black race domain (domain 4). Hence, for A.C.E. Black Hispanics are aggregated with Nonblack Hispanics into the Nonblack total, whereas for DA Black Hispanics are included in the Black figures. (The 1990 PES assigned Black Hispanics to the Black post-strata, so this issue did not arise then.) The implied DA estimates of Black Hispanics for 2000 were obtained by inflating the census counts of Black Hispanics by adjustment factors corresponding to the DA estimates of Black undercount¹, since separate DA estimates of Hispanic undercount are not available. Since Black Hispanics are only about four percent of the size of the Black population, and less than one percent of the size of the Nonblack population, this approximate coverage correction should be adequate for the purpose of estimating correlation bias.

The second adjustment to the DA totals is to subtract the census count of the group quarters (GQ) population. This adjustment is needed since the GQ population is not part of the A.C.E. universe. In the calculations shown here, the census GQ counts used are aggregations by age-sex groups for Black and Nonblack totals consistent with the DA race breakdown. Thus, we also need to subtract Black Hispanics in group quarters from the Black GQ counts and add them to the Nonblack GQ counts before making this adjustment. We actually carried this out by first subtracting the original Black and Nonblack GQ totals, and then adding the Black Hispanics in group quarters back for Blacks and subtracting them for Nonblacks. (In 1990 the military and institutional group quarters population was not part of the PES universe and was subtracted from 1990 DA estimates before comparing them to PES results. As this was a subset of the full group quarters population, this was a relatively smaller adjustment than that needed in 2000.)

Notice that in subtracting the census GQ counts from the DA totals we are ignoring possible undercoverage or overcoverage of the GQ population in the census. While it might be desirable to allow for census coverage errors of the GQ population in these calculations, separate estimates of census GQ population coverage are not available from either DA or A.C.E. Thus, to make

¹ Subsequent to generating the results reported in Bell (2001) an error was discovered in the implied DA estimates of Black Hispanics stemming from use of the same adjustment factors (those for males under Model 1 race assignment) to inflate the census counts of Black Hispanics for both males and females, and for both Model 1 and Model 2 race assignment. Correcting this error had small effects on correlation bias estimates (from the two-group model discussed in Section 4) for Black males (a maximum of 3/10 of one percent) and very small effects for Nonblacks. The original, uncorrected results are presented here as these results were the ones used in the initial assessments of correlation bias in the 2000 A.C.E. estimates.

coverage adjustments to the census GQ counts would require simply assuming some GQ coverage rate(s). Robinson (2001b) briefly discusses the issue of GQ coverage and its potential impact on comparing A.C.E. and DA estimates of census coverage.

In addition to the adjustments just discussed, we should also subtract estimates of the remote Alaska population from the DA estimates. The remote Alaska population, like the group quarters population, is not part of the A.C.E. universe. The size of this population is small, however, so its effects on comparisons of DA and A.C.E. totals is small, and its effects on DA sex ratios, and hence on estimates of correlation bias, is negligible. These adjustments were not made in obtaining the results shown here.

Once the DA totals are modified to be comparable to the A.C.E. totals we can use these results to compute modified DA sex ratios. These can then be compared to the A.C.E. sex ratios and used in estimating correlation bias in the A.C.E. DSEs.

To summarize, we use the following steps to modify the DA totals for comparability with the A.C.E. totals:

1. Start with the DA population totals for the seven A.C.E. age-sex groups (0-17 MF, 18-29 M, 18-29 F, 30-49 M, 30-49 F, 50+ M, 50+ F) by Black versus Nonblack race groups.
2. Subtract implied DA estimates of Black Hispanics from the DA totals for Blacks and add these same estimates to the DA totals for Nonblacks. The implied DA estimates of Black Hispanics for 2000 were obtained by inflating the census counts of Black Hispanics by adjustment factors corresponding to the DA estimates of Black undercount, since separate DA estimates of Hispanic undercount are not available.
3. Subtract the corresponding census counts of the GQ population from the results at step 2, since the A.C.E. universe just covers the household population, not group quarters.
4. Add census counts of Black Hispanics in group quarters to the results for Blacks in step 3 and subtract these same counts from the results for Nonblacks in step 3. This is necessary because the group quarters counts used at step 3 include Black Hispanics among Blacks as in DA. Equivalently, at step 3 we could subtract Black Hispanics in group quarters from the Black GQ counts and add them to the Nonblack GQ counts before subtracting the GQ counts at step 3.

Table 1 illustrates these calculations for males age 30-49 for both Blacks and Nonblacks using the Alt DA population estimates. Model 2 race assignment (discussed below) is used for the census counts involved.

Table 1. Modifying DA Population Estimates for Comparability with A.C.E. Estimates
Black and Nonblack Males, Age 30-49, Alt DA Population Estimates
(Model 2 race assignment used for census counts)

Modification steps	Black	Nonblack
1. DA population estimate (Alt DA)	5,655,841	37,989,214
2. DA Implied Black Hispanic population	! 224,335	+224,335
3. Census GQ population count	! 538,608	! 814,836
4. Census Black Hispanic GQ count	+14,913	! 14,913
Modified DA population estimate	4,907,811	37,383,800
A.C.E. estimate (sum of DSEs)	4,510,428	37,570,789
Percent difference ($100 \times (DA - A.C.E.) / DA$)	8.10%	! .50%

Notice that the modification to the Alt DA estimate for Blacks is relatively large due to the substantial figures for the group quarters population and the implied DA estimate of Black Hispanics, both of which get subtracted from the original DA estimate. Comparing the original, unmodified DA Black estimate to the A.C.E. estimate would clearly be misleading. The modification to the DA estimate for Nonblack males 30-49 is relatively much smaller, though still necessary.

While strictly correct, as noted above subtracting out the remote Alaska population has little effect on these results. With this adjustment the percent difference between the modified DA and A.C.E. estimates is unchanged to the digits shown for Blacks (the actual change is about .001%) and it only changes by $-.02\%$ for Nonblacks. Similar results occur for other age-sex groups: changes are a few hundredths of a percent for Nonblacks and less than one hundredth of a percent for Blacks.

Because the 2000 census allowed multiple responses to the census race question, in removing census GQ counts from the DA estimates an additional issue arises in regard to how the census GQ persons are assigned to the Black and Nonblack race groups. Robinson (2001a) explains how alternative census tabulations corresponding to alternative definitions of the Black and Nonblack race groups can be used in comparing DA to census results. He considers the following two extremes for assignment of individuals to the Black and Nonblack groups:

- Model 1: only those persons who checked only Black (and no other race) for the census race question are classified as Black.
- Model 2: in addition to those who checked only Black, persons who checked Black *and any other race* are also classified as Black.

In comparing DA and A.C.E. results, this issue affects only the census GQ population that is subtracted from the DA totals (including the Black Hispanic GQ counts). In particular, it affects the allocation of the GQ population to the Black and Nonblack race groups. Bell (2001) noted that this choice between Model 1 and Model 2 race assignment has appreciable effects on the comparison of DA and A.C.E. totals for Blacks, but quite small effects for Nonblacks. The effects on the DA sex ratios are negligible for both race groups, however, thus so are the effects on estimates of correlation bias using DA sex ratios. Hence, in this report we show results for only one race assignment of the census GQ population, namely, those under Model 2.

Appendix A gives the data used in the above calculations for all three sets of DA estimates and all the age-sex-race groups. Notice that the census counts at steps 3 and 4 remain the same for all the sets of DA estimates. The original DA estimates at step 1 are unaffected by the choice of Model 1 versus Model 2 for race assignment for the census counts, but the numbers used at steps 2-4 are affected by this choice. Step 2 is affected because it is obtained by inflating the census count of Black Hispanics by a DA estimated undercount rate for Blacks in the given age-sex group.

3. USING ALTERNATIVE DEMOGRAPHIC ANALYSIS ESTIMATES TO ASSESS POTENTIAL CORRELATION BIAS IN THE 2000 A.C.E. ESTIMATES

Previous results from comparing DA 2/16/2001 and 2000 A.C.E. estimates

Bell (2001) compared the 2000 A.C.E. estimates against the DA 2/16/01 estimates in terms of both totals and sex ratios. Correlation bias estimates were also produced, and comparisons were made against corresponding results for the 1990 PES. A brief summary of these results follows:

- The DA 2/16/01 totals were *lower* than A.C.E. totals for many of the age-race-sex groups. The difference was particularly large for Nonblack males and females 18-29 (-8.4 percent and -5.8 percent, respectively.) These results are hard to explain in terms of “correlation bias.” In fact, comparisons of DA and A.C.E. sex ratios for Nonblacks 18-29 are suspect given these results.
- The DA 2/16/01 sex ratios for adult Blacks significantly exceeded those for A.C.E., leading to estimates of significant correlation bias in DSEs for adult Black males. DA 2/16/01 sex ratios for Nonblacks 30-49 and 50 and over slightly exceeded those from A.C.E. leading to estimates of small amounts of correlation bias.
- These estimates of correlation bias in the 2000 A.C.E. were broadly similar to estimates that were previously obtained for the 1990 PES. They were very close for Black males 18-29 and 30-49, with some differences in magnitude for the other adult males. The one exception was

Nonblack males 18-29 which, in 1990, showed a small estimate of negative correlation bias. This contrasted with the problems noted above that in 2000 prevented estimating correlation bias for this group.

Comparing estimated population totals from 2000 alternative DA estimates with totals from the 2000 A.C.E. estimates

Tables 2 and 3 compare estimated population totals from DA and A.C.E. for the age-race-sex groups. Tables 2.a and 3.a provide results for all three alternative versions of the 2000 DA estimates. All are modified as discussed in Section 2 and, as noted there, use Model 2 race assignment of the census GQ population. Table 2.a gives the 2000 A.C.E. estimates along with the DA – ACE differences in terms of numbers of persons. Table 3.a shows percent differences defined as

$$100 \times (DA - ACE) / DA.$$

For comparison, Tables 2.b and 3.b show corresponding results for the 1990 DA and PES estimates. The results in Tables 2 and 3 might be taken as alternative DA estimates of the amount of underestimation or overestimation of the true population by A.C.E. Given the uncertainties in the DA totals, however, these are better interpreted simply as differences and percent differences.

We draw the following conclusions from these results:

- As with the original DA 2/16/01 estimates, for the Alt DA and DA 9/18/01 alternatives the 2000 DA totals are *lower* than A.C.E. totals for many of the age-race-sex groups. Again these differences are hard to explain in terms of “correlation bias,” and instead suggest some other inconsistency between the DA and A.C.E. estimates.
- There are changes of substance from the original to the two more recent versions of the DA estimates as can be seen from the Black and Nonblack totals (over the seven age-sex groups) in Table 2.a. Nonblack males and females 18-29 show the largest change from the original DA estimates – note their entries in Table 3.a. Their revised DA estimates move closer to the A.C.E. estimates, though they still remain substantially lower than the A.C.E. estimates.
- The groups that show the largest differences between the Alt DA and the DA 9/18/01 estimates are Black males and females 18-29 (Table 3.a). For these groups the DA 9/18/01 estimates are actually closer to the DA 2/16/01 estimates than to the Alt DA estimates.
- Comparisons for 1990 show some cases where DA totals are lower than the PES estimates, and the largest such differences again occur for Nonblack Males and Females 18-29. These differences, however, are nowhere near as large as those in the 2000 estimates.
- Despite the prevalence of negative entries in Tables 2.a and 3.a, the comparisons for adult

Black males show DA totals are significantly larger than the A.C.E. estimates, strongly suggesting correlation bias in the DSEs for these groups. This repeats the general result from 1990, though the 1990 results are more uniform across the age groups. As noted in Bell (2001), the comparisons for Blacks 50 and over may be affected by some significant revisions to the DA estimates for this group.

Table 2.a 2000 A.C.E. Estimates¹ and DA – A.C.E. Differences for Alternative DA Estimates²

BLACK				
Age-Sex	ACE Estimate	DA – ACE (DA 2/16/01)	DA – ACE (Alt DA)	DA – ACE (DA 9/18/01)
0-17 MF	11,546,755	-440,462	-362,814	-442,452
18-29 M	2,707,018	56,336	120,599	36,927
18-29 F	3,241,112	-176,458	-102,695	-182,835
30-49 M	4,510,428	340,317	397,383	385,777
30-49 F	5,530,246	-64,839	10,592	-22,490
50+ M	2,800,242	112,851	118,359	132,893
50+ F	3,874,974	-34,778	-21,873	-17,118
Total	34,210,775	-207,033	159,551	-109,298

NONBLACK				
0-17 MF	61,529,319	-831,693	-333,490	-179,486
18-29 M	19,731,526	-1,491,120	-880,120	-808,878
18-29 F	18,827,798	-992,954	-535,263	-696,927
30-49 M	37,570,789	-563,932	-186,989	-365,548
30-49 F	37,666,482	-732,407	-398,150	-684,675
50+ M	30,914,738	27,272	70,108	122,014
50+ F	36,397,458	-237,530	-187,453	-144,862
Total	242,638,110	-4,822,364	-2,451,357	-2,758,362

Notes to Table 2:

1. For 2000 the A.C.E. estimates based on 448 poststrata (collapsed to 416) are used. For 1990 the PES 357 poststrata estimates are used. In both cases the estimates are not of the total population but of the DSE universes.
2. For 2000 the three alternative versions of the DA estimates are as discussed in Section 1. The DA estimates for 2000 and 1990 are modified for comparison to the 2000 A.C.E. and 1990 PES estimates as discussed in Section 2.

Table 2.b 1990 PES Estimates¹ and DA – PES Differences

BLACK		
Age-Sex	PES Estimate	DA – ACE
0-17 MF	10,245,234	142,255
18-29 M	2,860,607	243,123
18-29 F	3,448,236	-6,579
30-49 M	3,816,693	322,402
30-49 F	4,563,792	4,371
50+ M	2,279,558	219,243
50+ F	3,181,307	19,270
Total	30,395,427	944,085
NONBLACK		
0-17 MF	55,214,482	-405,756
18-29 M	21,159,303	-372,850
18-29 F	20,816,231	-431,951
30-49 M	32,391,912	260,205
30-49 F	32,636,320	-276,983
50+ M	24,993,494	601,052
50+ F	30,730,792	371,635
Total	217,942,534	-254,648

Table 3.a 2000 A.C.E. Percent Differences from DA Estimates¹, $100 \times (DA - ACE) / DA$

BLACK						
	DA 2/16/01		Alt DA		DA 9/18/01	
Age	Male	Female	Male	Female	Male	Female
0-17 (MF)	-3.97	--	-3.24	--	-3.98	--
18-29	2.04	-5.76	4.27	-3.27	1.35	-5.98
30-49	7.02	-1.19	8.10	.19	7.88	-.41
50+	3.87	-.91	4.06	-.57	4.53	-.44

NONBLACK						
	DA 2/16/01		Alt DA		DA 9/18/01	
Age	Male	Female	Male	Female	Male	Female
0-17 (MF)	-1.37	--	-.54	--	-.29	--
18-29	-8.17	-5.57	-4.67	-2.93	-4.27	-3.84
30-49	-1.52	-1.98	-.50	-1.07	-.98	-1.85
50+	.09	-.66	.23	-.52	.39	-.40

Table 3.b 1990 PES Percent Differences from DA Estimates¹, $100 \times (DA - PES) / DA$

BLACK		
	DA 1990	
Age	Male	Female
0-17 (MF)	1.37	--
18-29	7.83	-.19
30-49	7.79	.10
50+	8.77	.60

NONBLACK		
	DA 1990	
Age	Male	Female
0-17 (MF)	-.74	--
18-29	-1.79	-2.12
30-49	.80	-.86
50+	2.35	1.19

Notes to Table 3:

1. See Notes to Table 2 for information about the estimates used here (2000 and 1990 DA, 2000 A.C.E., and 1990 PES).
2. Results shown under Male for 0-17 (MF) are actually for the aggregation of both males and females.

Comparing sex ratios from alternative DA estimates and A.C.E. estimates

Sex ratios from the 2000 A.C.E. and alternative DA estimates are given in Table 4.a, and corresponding results for the 1990 PES and 1990 DA estimates are given in Table 4.b. We draw the following conclusions from these results.

- Under all three alternatives the 2000 DA sex ratios for adult Blacks significantly exceed those for A.C.E., strongly suggesting correlation bias in DSEs for adult Black males. The 2000 DA sex ratios for adult Blacks show relatively little variation over the three DA alternatives.
- Under all three alternatives the 2000 DA sex ratios for Nonblacks 30-49 and 50 and over only slightly exceed those from A.C.E. suggesting at most small amounts of correlation bias. Again the variation in these sex ratios across the three DA alternatives is small.
- The sex ratio for Nonblacks 18-29 from the original (2/16/01) DA estimates (1.023) differs substantially from the A.C.E. sex ratio (1.048). However, the revisions to the DA estimates bring the DA sex ratio for this group considerably closer to the A.C.E. sex ratio: the sex ratio for Alt DA is 1.031 and that for the DA 9/18/01 estimates is 1.044. Since these values are still lower than the A.C.E. sex ratio, however, uncritical use of this data would lead to a small estimate of positive correlation bias suggesting some overestimation by the DSEs. Because positive correlation bias seems unreasonable, with the revised DA estimates we still do not use the DA data to estimate correlation bias for Nonblacks 18-29. We set the correlation bias estimate to zero instead.
- Except for Nonblacks 18-29, the sex ratio comparisons between DA and A.C.E. in 2000 are reasonably similar to the corresponding comparisons for 1990.

Table 4.a 2000 DA and 2000 A.C.E. Sex Ratios¹
(using alternative DA estimates)

BLACK				
Age	DA 2/16/01	Alt DA	DA 9/18/01	2000 ACE
18-29	.902	.901	.897	.835
30-49	.888	.886	.889	.816
50+	.759	.758	.760	.723

NONBLACK				
18-29	1.023	1.031	1.044	1.048
30-49	1.002	1.003	1.006	.998
50+	.856	.856	.856	.849

Table 4.b 1990 DA and 1990 PES Sex Ratios¹

BLACK		
Age	1990 DA	1990 PES
18-29	.902	.830
30-49	.906	.836
50+	.781	.717

NONBLACK		
18-29	1.020	1.017
30-49	1.009	.993
50+	.823	.813

Note to Table 4:

1. See Notes to Table 2 for information about the estimates used in computing the sex ratios given here (2000 and 1990 DA, 2000 A.C.E., and 1990 PES). Note that the DA sex ratios are computed from the DA estimates modified for comparability with the 2000 A.C.E. and 1990 PES results as discussed in the Notes to Table 1.

4. ESTIMATING CORRELATION BIAS IN ADULT MALE DSEs FROM THE 2000 A.C.E. USING ALTERNATIVE DA SEX RATIOS

Alternative models for estimating correlation bias in DSEs are presented in Bell (1993) and Bell et al. (1996). Elliott and Little (2000) developed statistical refinements to this approach, but it was impossible to implement their refinements in the time available. These refinements are likely to be less important than alternative choices of the model used. The approach of Elliott and Little (2000) is planned for use in later evaluations.

All the models used here assume no correlation bias for adult females and use the DA sex ratios and the A.C.E. data to produce correlation bias estimates for adult males. Correlation bias estimates for the 2000 A.C.E. estimates were obtained using the DA 2/16/01 estimates in Bell (2001). These results are also given and discussed below, and compared with results from the other two DA alternatives.

Correlation bias estimates from the “two-group model”

We begin with results from a particularly simple model that assumes relative correlation bias (percent error) is constant over male post-strata within adult age groups for Blacks and Nonblacks. This model is discussed in Bell (1999). The model has been called the two-group model because it can be derived by postulating two groups of people within each male post-stratum (say hard-to-count and easy-to-count), and making certain assumptions about the relation between the two groups’ census and A.C.E. inclusion probabilities and their relative size. Under the two-group model, within each age-race (Black versus Nonblack) group, the relative correlation bias in the male post-strata is estimated by the percent difference between the A.C.E. sex ratio and the DA sex ratio, that is,

$$\text{Percent correlation bias} = 100 \left(\frac{\text{A.C.E. sex ratio}}{\text{DA sex ratio}} - 1 \right)$$

Table 5 gives these estimates of percent correlation bias from the two-group model for the 2000 A.C.E. estimates using the three alternative DA estimates. The table also gives corresponding results for the 1990 PES estimates. The results show the following:

- The correlation bias estimates are fairly similar across the three alternative DA estimates for 2000, except for Nonblacks 18-29. These results derive from the similarity of the DA sex ratios across the three alternatives (except for Nonblacks 18-29).
- The two-group model estimates of correlation bias for Blacks 18-29 and 30-49 in 2000 are fairly similar to those in 1990, implying around seven to eight percent underestimation by the DSEs (apart from other biases in the DSEs).
- The estimates of correlation bias for Blacks 50 and over in 2000 (–4.74 to –4.95 percent) are

smaller in size than in 1990 (–8.2 percent). This may be partly due to revisions to the DA estimates for the cohort of Black males who were 65-75 in 2000, as noted in Bell (2001).

- Estimates of correlation bias for Nonblack Males 30-49 and 50 and over are negative and relatively small in magnitude. Similar results were obtained for 1990, though the 1990 estimates were slightly larger in magnitude.
- The correlation bias estimates for Nonblack males 18-29 are positive for all three 2000 DA alternatives, though the estimates declined significantly from the 2/16/01 through Alt DA to the DA 9/18/01 estimates. Positive estimates are hard to explain as “correlation bias.” Possible causes of such a result are that males in this group who were more likely than others to be missed in the census were less likely than others to be missed in the A.C.E., or that females in this group exhibited a larger amount of conventional correlation bias than did males. Neither of these explanations makes much sense. Thus, with the revised DA estimates, we conclude as we did with the original DA estimates in Bell (2001) that we cannot estimate correlation bias for Nonblacks 18-29.
- Given this conclusion, we decided to proceed by assuming no correlation bias for Nonblack males 18-29 on the grounds that
 - the 2000 estimates of relative correlation bias for older Nonblack males are small, and
 - the 1990 estimate of relative correlation bias for Nonblack males 18-29 was small.

Table 5 Percent Correlation Bias Estimates¹ (from two-group model) for 2000 A.C.E. and 1990 PES

(Three alternative DA estimates² used for 2000.)

BLACK				
	2000 Correlation Bias Estimates (Percent)			1990 Correlation Bias
Age	DA 2/16/01	Alt DA	DA 9/18/01	
18-29	-7.37	-7.30	-6.91	-8.01
30-49	-8.10	-7.93	-8.26	-7.70
50+	-4.74	-4.60	-4.95	-8.22
NONBLACK				
18-29	2.47	1.69	.41	-.32
30-49	-.45	-.56	-.85	-1.64
50+	-.74	-.74	-.79	-1.17

Notes to Table 5:

1. Percent correlation bias is estimated for adult males (in each age-race group) by the two group model as

$$100 \left(\frac{\text{A.C.E. sex ratio}}{\text{DA sex ratio}} - 1 \right)$$

This model, and the other models used here, assume no correlation bias for adult females.

2. See Notes to Table 2 for information about the estimates used (2000 and 1990 DA, 2000 A.C.E., and 1990 PES) in computing these results.

Correlation bias estimates from alternative models

We estimated correlation bias for the male post-strata using the alternative models listed in Table 6. The first model is the two-group model already discussed. Models 2-5 were presented in Bell (1993) and are discussed also in Elliott and Little (2000). Model 6 is discussed by Das Gupta in Appendix B of Bell et al. (1996). Model 7 is a modification of the two-group model that assumes the same correlation bias for Blacks and Hispanics, but different correlation bias for Nonblack Nonhispanics. Estimation details for this model are given in Appendix B.

Table 6. Alternative Models¹ for Estimating Correlation Bias in DSEs Using DA Sex Ratios

Model	Assumption
1. Two-group or fixed relative bias (FRB)	Correlation bias ² proportional to population of post-stratum, implying relative correlation bias ² constant over post-strata.
2. Fixed odds ratio (FOR)	Correlation bias in post-stratum proportional to persons missed by both the census and A.C.E., the (2,2) cell.
3. Fixed relative risk (FRR)	Correlation bias in post-stratum proportional to persons missed by the census.
4. Fixed ratio of male to female p ₂₂ (MF22)	Ratio of male to female probabilities for (2,2) cell constant over post-strata.
5. Generalized behavioral response estimator (BRE)	Pr[in ACE not in census] / Pr[in census] constant over post-strata.
6. Prithwis Das Gupta's model (PDG)	Pr[in ACE or census for males] / Pr[in ACE or census for females] constant over post-strata.
7. Modified two-group model for Blacks and Hispanics	Relative correlation bias constant over male post-strata (within age-race groups) as in two-group model, but we assume the same correlation bias for Blacks and Hispanics, and different correlation bias for Nonblack Nonhispanics.

Notes to Table 6:

1. The models derive from the alternative assumptions shown that state that some quantity (parameter) is constant across all male post-strata within an age-race (Nonblack versus Black) group.
2. If N is the true population then (arithmetic) correlation bias is $E(DSE) - N$ and relative correlation bias is $[E(DSE) - N] / N$.

All the models assume no correlation bias for females, that DA sex ratios are accurate, and that some quantity related to correlation bias (model parameter) is constant over male post-strata within age-race groups. Estimation of correlation bias for Model 1 was just discussed, and estimation of Model 7 is discussed in Appendix B. For Models 2-6 we estimate the model parameter and correlation bias for the male post-strata following these steps:

1. Aggregate DSEs for females to the national level within age-race groups (Black vs.

Nonblack race).

2. Multiply the female totals by corresponding DA sex ratios to get control totals for males.
3. Determine the model parameter so that the resulting estimates for male post-strata (which are unbiased assuming the model is true) aggregate to the control totals from step 2.
4. Differences between these estimates and the usual DSEs estimate correlation bias for adult male post-strata. Relative (percent) differences estimate relative (percent) correlation bias.

If N is the true population in a post-stratum then the (arithmetic) correlation bias in the DSE is $E(\text{DSE}) - N$ and the relative correlation bias is $[E(\text{DSE}) - N] / N$.

Estimates of the parameters of the alternative models are given in Appendix C for the adult age groups for Black and Nonblack. Results for the 2000 A.C.E. are given for the three alternative versions of the DA estimates. Generally speaking the parameter estimates do not vary much according to which 2000 DA estimates are used. Results are also given for the 1990 PES. Results for 2000 for Nonblacks 18-29 are included only for completeness; the estimated models for this group were not used to produce correlation bias estimates by post-strata. In fact, when using sex ratios from the DA 2/16/01 and Alt DA estimates, the estimates of the FOR and MF22 model parameters are essentially set at their boundary values of 0, and even these values did not allow these models to reproduce the control totals noted in estimation step 3 above. This strongly suggests that, whatever is the reason for the discrepancy between the DA and A.C.E. results for Nonblacks 18-29, it is not due to correlation bias for males.

Estimates of correlation bias for individual adult male post-strata can be obtained as $\text{DSE} - N_{\text{alt}}$, where N_{alt} is the population estimate from the alternative model, which is unbiased under the model assumptions. Estimates of relative correlation bias are then $[\text{DSE} - N_{\text{alt}}] / N_{\text{alt}}$. Appendix D gives these estimates of relative correlation bias for 2000 obtained from the Alt DA and DA 9/18/01 estimates for all the adult male post-strata except those for Nonblacks 18-29. Corresponding results for the DA 2/16/01 estimates were given in Bell (2001). For these calculations post-stratum groups that were collapsed over age were synthetically uncollapsed proportional to the individual post-stratum census counts as described in Bell (1993).

For the two-group model the post-stratum estimates of correlation bias (Appendix D) are constant for a given age-race group because this model assumes that relative correlation bias is constant in this way. This is also true for the modified two-group model (Model 7) when the race groups are defined as Black or Hispanic and Nonblack Nonhispanic. For the other models the estimates of relative correlation bias vary significantly over post-strata, showing that the model assumed for estimating correlation bias by post-strata has a significant impact on the results. As noted in Bell (1993), all the alternative models fit the data equally well (all are saturated models), and so the data give no information about whether one or the other of the models should be preferred. For this reason, when using post-stratum correlation bias estimates

in such things as loss function analyses (see Mulry and Spencer 1993), it is useful to obtain results using correlation bias estimates from several of these alternative models, to check if the results of interest depend on the model used.

5. FURTHER RESEARCH

There are three projects currently planned or already underway to further investigate correlation bias in the 2000 A.C.E. DSEs.

- Development of the 2000 total error model (Petroni 2001) is drawing on results of various evaluation studies to produce overall estimates of bias other than correlation bias in the 2000 A.C.E. estimates. When these results are finalized the estimated biases can be used to adjust the DSEs for bias, and these bias-adjusted DSEs can be used when estimating correlation bias. This will avoid the problem of other biases potentially contaminating the estimate of correlation bias, an issue raised by Wachter and Freedman (1999). With an aggregate bias adjustment of the DSEs the two-group or modified two-group models can be used, since the estimates of correlation bias for these models depend only on the DA sex ratios used and on the DSEs. For the other models listed in Table 6 correlation bias estimates depend on more detailed data — cells of the poststratum 2×2 tables used in DSE. It is hoped that eventually results of the total error evaluations can be used to bias adjust this more detailed data so that correlation bias estimates can be obtained from bias adjusted data for these other models.
- Another revised set of DA estimates is in progress, incorporating some additional data and input from outside experts on international migration. When these revised estimates are completed correlation bias will be reestimated using the new DA sex ratios.
- Michael Elliott is working to modify computer software to apply to the 2000 A.C.E. data the approach to estimating correlation bias developed in Elliott and Little (2000). This follows the same general idea as the approach used here (for which see Bell 1993), using the same basic models, but with certain statistical refinements, such as in how post-strata with negative cells are handled. (Negative cells occur when the sample weighted matches for a post-stratum exceed the post-stratum census count reduced by estimated erroneous enumerations.) We hope to develop the bias-corrected A.C.E. data as noted above for input to these calculations.

APPENDIX A. ALTERNATIVE DEMOGRAPHIC ANALYSIS ESTIMATES AND DATA FOR MAKING COMPARABILITY ADJUSTMENTS (TO DA FOR COMPARISONS TO THE A.C.E. ESTIMATES)

Table A.1 DA 2/16/01 population estimates

	BLACK		NONBLACK	
Age	Male	Female	Male	Female
0-17	6,021,380	5,861,590	30,850,097	29,393,763
18-29	3,470,922	3,463,204	19,607,553	18,708,145
30-49	5,601,221	5,806,463	37,609,825	36,895,306
50+	3,143,582	4,085,829	31,570,720	37,508,521

Table A.2 Alt DA population estimates

	BLACK		NONBLACK	
Age	Male	Female	Male	Female
0-17	6,038,300	5,880,958	31,120,495	29,662,928
18-29	3,532,123	3,521,016	20,221,615	19,181,787
30-49	5,655,841	5,858,602	37,989,214	37,252,855
50+	3,147,813	4,092,202	31,614,833	37,565,130

Table A.3 DA 9/18/01 population estimates

	BLACK		NONBLACK	
Age	Male	Female	Male	Female
0-17	5,996,105	5,839,073	31,228,753	29,713,116
18-29	3,443,771	3,436,502	20,297,537	19,024,497
30-49	5,643,767	5,824,214	37,811,123	36,967,636
50+	3,162,745	4,097,079	31,666,341	37,607,599

**Table A.4 DA implied estimates of Black Hispanics (three alternative DA estimates)
(Model 2 race assignment)**

	DA 2/16/01		Alt DA		DA 9/18/01	
Age	Male	Female	Male	Female	Male	Female
0-17	338,446	328,770	316,834	309,022	314,605	306,809
18-29	190,780	198,207	187,718	182,256	183,038	177,882
30-49	226,781	247,942	224,335	224,650	223,867	223,344
50+	85,140	109,572	83,863	103,040	84,261	103,162

**Table A.5 Census 2000 GQ counts for Blacks and Nonblacks
(Model 2 race assignment)**

	BLACK		NONBLACK	
Age	Male	Female	Male	Female
0-17	78,848	37,046	135,994	71,023
18-29	536,005	208,290	1,538,710	1,063,561
30-49	538,608	95,742	814,836	206,545
50+	148,496	137,735	710,703	1,456,491

**Table A.6 Census counts of the Black Hispanic population in group quarters
(Model 2 race assignment)**

Age	Male	Female
0-17	4,018	2,415
18-29	19,217	7,947
30-49	14,913	2,628
50+	3,147	1,674

**Table A.7 DA 2/16/01 pop estimates modified for Black Hispanics and Census GQ counts
(Model 2 race assignment)**

	BLACKS		NONBLACKS	
Age	Males	Females	Males	Females
0-17	5,608,104	5,498,189	31,048,531	29,649,095
18-29	2,763,354	3,064,654	18,240,406	17,834,844
30-49	4,850,745	5,465,407	37,006,857	36,934,075
50+	2,913,093	3,840,196	30,942,010	36,159,928

**Table A.8 Alt DA pop estimates modified for Black Hispanics and Census GQ counts
(Model 2 race assignment)**

	BLACKS		NONBLACKS	
Age	Males	Females	Males	Females
0-17	5,646,636	5,537,305	31,297,317	29,898,512
18-29	2,827,617	3,138,417	18,851,406	18,292,535
30-49	4,907,811	5,540,838	37,383,800	37,268,332
50+	2,918,601	3,853,101	30,984,846	36,210,005

**Table A.9 DA 9/18/01 pop estimates modified for Black Hispanics and Census GQ counts
(Model 2 race assignment)**

	BLACKS		NONBLACKS	
Age	Males	Females	Males	Females
0-17	5,606,670	5,497,633	31,403,346	29,946,487
18-29	2,743,945	3,058,277	18,922,648	18,130,871
30-49	4,896,205	5,507,756	37,205,241	36,981,807
50+	2,933,135	3,857,856	31,036,752	36,252,596

APPENDIX B. ESTIMATION OF THE MODIFIED TWO-GROUP MODEL

The two-group model assumes that the bias in adult male DSEs takes the form

$$E(DSE_{Mj}) = \eta \times N_{Mj}$$

where, for each post-stratum j within a given age-race group, DSE_{Mj} is the male DSE, N_{Mj} is the true male population, and η is the parameter reflecting correlation bias in the DSEs ($\eta = 1$ means no correlation bias.) In the original two-group model the race groups used are Black and Nonblack, so η is allowed to vary across the three age groups (18-29, 30-49, and 50+) for both Blacks and Nonblacks (six different values for η). The relative correlation bias in DSE_{Mj} is $[E(DSE_{Mj}) - N_{Mj}] / N_{Mj} = \eta - 1$. Section 4 notes that, under the model assumptions including no correlation bias for females, $\eta - 1$ can be estimated by the relative difference of the A.C.E. and DA sex ratios. The corresponding estimate of η is simply (A.C.E. sex ratio) / (DA sex ratio).

In the “modified two-group model” we assume that Blacks and Hispanics have the same η ’s, which are different from the η ’s for Nonblack Nonhispanics. To estimate this model we start with the results for Blacks from the original two-group model. The correlation bias estimates for Blacks remains the same as with the original two-group model, and the correlation bias estimates for Hispanics are merely set equal to the correlation bias estimates for Blacks.

To estimate correlation bias for Nonblack Nonhispanics in this model we proceed as follows. Let $N_{M,NH}$ denote the true male Nonblack Nonhispanic population total (over the post-strata in the given age group). We can write this as the difference between the full male Nonblack population total ($N_{M,NB}$) and the male Hispanic population total ($N_{M,H}$). Then, using the model assumptions, we can break this down further as follows:

$$\begin{aligned} N_{M,NH} &= N_{M,NB} - N_{M,H} \\ &= E(DSE_{F,NB}) \times \rho_{NB} - E(DSE_{M,H}) / \eta_B \end{aligned}$$

where $DSE_{F,NB}$ is the total of the female Nonblack Nonhispanic DSEs (which are assumed to be unbiased estimates of the true female populations), ρ_{NB} is the Nonblack DA sex ratio (after modifying DA estimates for comparability to the DSEs), $DSE_{M,H}$ is the total of the male Hispanic DSEs, and η_B , the correlation bias parameter for Blacks, is also the correlation bias parameter for Hispanics. If, in the above equation, we drop the mathematical expectations, substitute in for the DA sex ratio, and substitute in our estimate of η_B already computed, we have an estimate of $N_{M,NH}$ that is approximately unbiased under the model assumptions. The estimate of η_{NH} , the correlation bias parameter for Nonblack Nonhispanics, is then

$$\hat{\eta}_{NH} = \frac{DSE_{M,NH}}{N_{M,NH}}.$$

APPENDIX C. ESTIMATES OF CORRELATION BIAS PARAMETERS

FOR ALTERNATIVE MODELS

Estimates of the two-group model parameter η are simply one plus the relative correlation bias estimates given in Table 5 (dividing the percentages shown there by 100). Estimation results for models 2-5 for the 1990 PES (357 post-strata) were given in Bell (1993). For the FOR, FRR, and MF22 models, values of the parameters exceeding 1 indicate negative correlation bias resulting in underestimation by DSEs. For the two-group, BRE, and Das Gupta models values of the parameters less than 1 indicate negative correlation bias resulting in DSE underestimation. Actually, for the MF22, BRE, and Das Gupta this is not quite true, since the DSE assuming independence is not a special case of these models. For these three models under the conditions cited it is more appropriate to say there is a tendency for the usual DSEs to underestimate, though this need not be uniformly true across post-strata.

**Table C.1 Parameter Estimates for Alternative Models¹ to Estimate Correlation Bias
Results for 2000 A.C.E. using DA 2/16/01 estimates**

	Age	2-group (O)	FOR (2)	FRR (())	MF22 (D)	BRE (8)	Das Gupta
Blacks	18-29	.926	3.34	1.44	5.44	.76	.912
	30-49	.919	4.86	1.60	7.96	.69	.909
	50+	.953	5.17	1.49	8.69	.71	.947
Nonblacks	18-29	1.025	0.00	.82	0.00	1.24	1.017
	30-49	.995	1.81	1.06	3.71	1.00	.993
	50+	.992	3.02	1.12	3.97	.92	.992

**Table C.2 Parameter Estimates for Alternative Models¹ to Estimate Correlation Bias
Results for 2000 A.C.E. using Alt DA estimates**

	Age	2-group (O)	FOR (2)	FRR (())	MF22 (D)	BRE (8)	Das Gupta
Blacks	18-29	.927	3.32	1.44	5.40	.77	.913
	30-49	.921	4.77	1.58	7.83	.70	.911
	50+	.954	5.04	1.48	8.50	.72	.949
Nonblacks	18-29	1.017	.01	.87	.01	1.17	1.009
	30-49	.994	2.00	1.07	4.09	.99	.991
	50+	.993	3.02	1.12	3.97	.92	.992

**Table C.3 Parameter Estimates for Alternative Models¹ to Estimate Correlation Bias
Results for 2000 A.C.E. using DA 9/18/01 estimates**

	Age	2-group (O)	FOR (2)	FRR (())	MF22 (D)	BRE (8)	Das Gupta
Blacks	18-29	.931	3.19	1.41	5.22	.78	.916
	30-49	.917	4.94	1.61	8.07	.69	.908
	50+	.950	5.36	1.52	8.99	.71	.945
Nonblacks	18-29	1.004	.75	.97	1.34	1.08	.997
	30-49	.992	2.52	1.10	5.09	.96	.989
	50+	.992	3.14	1.13	4.13	.92	.991

**Table C.4 Parameter Estimates for Alternative Models¹ to Estimate Correlation Bias
Results for 1990 PES**

	Age	2-group (O)	FOR (2)	FRR (())	MF22 (D)	BRE (8)	Das Gupta
Blacks	18-29	.920	2.87	1.43	3.50	.76	.907
	30-49	.923	2.94	1.47	5.30	.72	.901
	50+	.918	6.81	1.91	8.50	.58	.913
Nonblacks	18-29	.997	1.19	1.02	1.77	1.01	.991
	30-49	.984	3.64	1.23	6.17	.86	.981
	50+	.988	4.05	1.26	4.26	.81	.988

Note to Tables C.1-C.4

1. The alternative models are those listed in Table 4. For the FOR, FRR, and MF22 models values of the parameters exceeding 1 indicate negative correlation bias resulting in underestimation by DSEs. For the 2-group, BRE, and Das Gupta models values of the parameters less than 1 indicate negative correlation bias resulting in DSE underestimation. Actually, for the MF22, BRE, and Das Gupta models this is not quite true, since the DSE assuming independence is not a special case of these models. For these models under the conditions cited it is more appropriate to say there is a tendency for the usual DSEs to underestimate, though this need not be uniformly true across post-strata.

APPENDIX D. ESTIMATES OF RELATIVE CORRELATION BIAS FROM ALTERNATIVE MODELS

Tables D.1 - D.5 Correlation bias estimates using Alt DA sex ratios

Table D.1 Blacks, age 18 - 29

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-7.30	-.68	-4.70	-2.47	-5.52	-8.94	-7.30
42	-7.30	-8.77	-6.22	-16.67	-2.14	-8.35	-7.30
43	-7.30	-6.99	-5.81	-4.04	-2.82	-6.94	-7.30
44	-7.30	-1.90	-8.69	-13.66	-16.87	-10.43	-7.30
45	-7.30	-11.72	-8.23	-10.96	-4.78	-6.08	-7.30
46	-7.30	-4.69	-9.62	-.26	-18.55	-7.18	-7.30
47	-7.30	-8.52	-7.98	-6.18	-7.41	-6.68	-7.30
48	-7.30	-4.41	-7.21	.42	-8.89	-7.16	-7.30

Table D.2 Blacks, age 30 - 49

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-7.93	-2.88	-5.77	-3.51	-5.62	-8.70	-7.93
42	-7.93	-12.02	-8.82	-16.63	-6.77	-7.86	-7.93
43	-7.93	-5.36	-5.08	-3.25	-3.21	-8.09	-7.93
44	-7.93	.00	-7.11	.00	-9.78	-8.92	-7.93
45	-7.93	-13.28	-9.49	-15.07	-7.68	-7.31	-7.93
46	-7.93	-7.72	-11.16	-4.06	-17.44	-7.59	-7.93
47	-7.93	-8.76	-8.99	-3.03	-9.45	-7.20	-7.93
48	-7.93	-6.98	-9.41	-.30	-11.86	-7.34	-7.93

Table D.3 Blacks, age 50+

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-4.60	-1.97	-3.05	-1.55	-2.64	-4.89	-4.60
42	-4.60	-4.53	-4.34	-3.09	-3.60	-4.48	-4.60
43	-4.60	-5.05	-3.79	-4.49	-2.44	-4.52	-4.60
44	-4.60	.00	-2.93	.00	-3.25	-5.13	-4.60
45	-4.60	-8.93	-6.30	-13.63	-5.52	-4.57	-4.60
46	-4.60	-4.26	-8.02	1.11	-13.30	-4.07	-4.60
47	-4.60	-8.59	-6.97	-7.96	-7.49	-4.03	-4.60
48	-4.60	-7.45	-7.83	-.50	-10.82	-3.48	-4.60

Table D.4 Nonblacks, age 30 - 49

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
1	-.56	.00	-.35	.00	-.34	-.86	.73
2	-.56	.00	-.24	.00	-.17	-.86	.73
3	-.56	-.11	-.33	.11	-.20	-.75	.73
4	-.56	.00	-.34	.00	-.33	-.86	.73
5	-.56	-.43	-.37	.33	.10	-.45	.73
6	-.56	-1.04	-.39	-2.33	.76	-.63	.73
7	-.56	-2.01	-.56	-3.75	1.56	-.20	.73
8	-.56	-.53	-.57	.53	-.29	-.33	.73
9	-.56	-.13	-.26	-.44	-.05	-.86	.73
10	-.56	.00	-.20	.00	-.12	-.86	.73
11	-.56	.00	-.33	.00	-.31	-.86	.73
12	-.56	.00	-.31	.00	-.27	-.86	.73
13	-.56	.00	-.18	.00	-.10	-.86	.73
14	-.56	-.87	-.42	-1.92	.51	-.66	.73
15	-.56	-.96	-.51	-2.69	.41	-.78	.73
16	-.56	-1.89	-.84	.73	.37	.78	.73
17	-.56	-.57	-.35	-.46	.30	-.54	.73
18	-.56	-.07	-.26	.07	-.11	-.78	.73
19	-.56	-.03	-.35	.03	-.32	-.83	.73
20	-.56	-.70	-.34	.39	.45	-.23	.73
21	-.56	.00	-.43	.00	-.52	-.86	.73
22	-.56	.00	-.75	.00	-1.67	-.86	.73
23	-.56	-.63	-.61	-.33	-.31	-.46	.73
24	-.56	-1.89	-.70	-4.32	.96	-.44	.73
25	-.56	-.67	-.42	-1.86	.28	-.80	.73
26	-.56	-.35	-.22	-.48	.23	-.71	.73
27	-.56	-.86	-.44	-.56	.44	-.34	.73
28	-.56	.00	-.76	.00	-1.71	-.86	.73
29	-.56	.00	-.37	.00	-.38	-.86	.73
30	-.56	-.89	-.41	.90	.55	.04	.73
31	-.56	-.47	-.61	.47	-.49	-.39	.73
32	-.56	-2.81	-.90	-1.64	1.35	.97	.73
33	-.56	-.13	-.78	-.34	-1.64	-.84	.73
34	-.56	-1.56	-1.17	-2.21	-2.30	-.19	.73
35	-.56	-.67	-.72	-.89	-.66	-.56	.73
36	-.56	-1.95	-1.10	.16	-1.10	.70	.73
37	-.56	-.83	-.80	-1.40	-.84	-.57	.73
38	-.56	.00	-1.11	.00	-4.06	-.86	.73
39	-.56	-.64	-.83	-.73	-1.25	-.55	.73
40	-.56	-.26	-1.11	.26	-3.66	-.60	.73
49	-.56	-.36	-.51	.13	-.31	-.55	-7.93
50	-.56	-1.31	-.78	.03	-.13	.15	-7.93
51	-.56	-1.17	-.58	-2.12	.45	-.48	-7.93
52	-.56	-2.03	-.56	-5.11	1.58	-.51	-7.93
53	-.56	-1.91	-1.01	.00	-.53	.63	-7.93
54	-.56	.00	-1.38	.00	-6.86	-.86	-7.93
55	-.56	-2.61	-1.24	-4.23	-1.27	.18	-7.93
56	-.56	-2.43	-1.92	2.55	-11.66	1.67	-7.93
57	-.56	-.75	-1.13	-.54	-3.17	-.42	.73
58	-.56	-.61	-.96	-4.42	-2.05	-1.47	.73
59	-.56	-.29	-.51	-.86	-.40	-.85	.73
60	-.56	-1.01	-.93	-3.23	-1.31	-.87	.73
61	-.56	-4.09	-.99	-10.98	2.79	-.19	.73
62	-.56	-2.69	-.86	-6.46	1.40	-.30	.73
63	-.56	-1.42	-.53	-9.37	.91	-2.03	.73
64	-.56	-2.93	-.99	-5.54	1.06	.13	.73

Table D.5 Nonblacks, age 50+

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
1	-.74	.00	-.49	.00	-.54	-.83	-.44
2	-.74	-.38	-.30	-.21	-.06	-.75	-.44
3	-.74	-.56	-.56	-.17	-.33	-.67	-.44
4	-.74	.00	-.44	-.02	-.47	-.84	-.44
5	-.74	-1.14	-1.02	-1.51	-.95	-.79	-.44
6	-.74	-2.06	-.70	-2.23	.36	-.61	-.44
7	-.74	-2.36	-.67	-2.78	.60	-.63	-.44
8	-.74	-1.06	-1.02	.53	-1.00	-.31	-.44
9	-.74	-.91	-.43	-1.12	.07	-.78	-.44
10	-.74	.00	-.28	-.06	-.26	-.85	-.44
11	-.74	-.23	-.60	.11	-.60	-.72	-.44
12	-.74	.00	-.45	.00	-.48	-.83	-.44
13	-.74	.00	-.33	.00	-.31	-.83	-.44
14	-.74	-.73	-.53	-.98	-.17	-.81	-.44
15	-.74	-2.63	-.85	-1.61	.43	-.23	-.44
16	-.74	-3.09	-.94	-2.42	.55	-.25	-.44
17	-.74	-.84	-.39	-1.90	.09	-1.00	-.44
18	-.74	-.23	-.40	-.46	-.28	-.86	-.44
19	-.74	.00	-.50	.00	-.56	-.83	-.44
20	-.74	-.26	-.39	-.50	-.25	-.86	-.44
21	-.74	.00	-.77	.00	-1.06	-.83	-.44
22	-.74	.00	-.78	.00	-1.09	-.83	-.44
23	-.74	.00	-.83	.00	-1.19	-.83	-.44
24	-.74	-1.09	-.70	-.31	-.24	-.50	-.44
25	-.74	-.24	-.99	.12	-1.45	-.71	-.44
26	-.74	-1.01	-.53	-1.28	-.01	-.78	-.44
27	-.74	-.88	-.94	-1.32	-.91	-.84	-.44
28	-.74	.00	-1.16	.00	-2.11	-.83	-.44
29	-.74	-.58	-1.21	.29	-1.89	-.55	-.44
30	-.74	-1.28	-.73	-.49	-.20	-.48	-.44
31	-.74	-1.04	-.77	-.87	-.41	-.66	-.44
32	-.74	-1.76	-1.29	-3.15	-1.32	-.96	-.44
33	-.74	-.09	-1.14	-1.75	-1.97	-1.24	-.44
34	-.74	-3.18	-1.43	-4.69	-.78	-.78	-.44
35	-.74	-.26	-1.02	-1.18	-1.52	-1.03	-.44
36	-.74	-4.66	-2.09	-3.80	-2.68	.06	-.44
37	-.74	-1.36	-1.11	-.34	-1.04	-.41	-.44
38	-.74	-.22	-1.77	-.24	-4.48	-.81	-.44
39	-.74	.00	-1.42	.00	-3.03	-.83	-.44
40	-.74	-1.62	-2.03	-.15	-4.86	-.26	-.44
49	-.74	-.94	-.65	-1.04	-.25	-.75	-4.60
50	-.74	-3.59	-1.11	-2.25	.48	.00	-4.60
51	-.74	-.55	-.67	-.89	-.52	-.85	-4.60
52	-.74	-1.63	-.90	-2.53	-.34	-.85	-4.60
53	-.74	-3.14	-1.50	-1.34	-1.10	.04	-4.60
54	-.74	.00	-2.30	.00	-8.01	-.83	-4.60
55	-.74	-.35	-2.14	-1.73	-6.58	-1.14	-4.60
56	-.74	-4.77	-3.41	2.55	-15.57	1.69	-4.60
57	-.74	-1.51	-2.03	-.50	-4.93	-.39	-.44
58	-.74	-1.22	-1.72	-4.28	-3.45	-1.45	-.44
59	-.74	-1.31	-.85	-.86	-.43	-.56	-.44
60	-.74	-2.50	-1.37	-3.71	-1.09	-.81	-.44
61	-.74	-7.72	-1.94	-6.46	.78	.76	-.44
62	-.74	-5.64	-1.37	-20.66	1.24	-3.73	-.44
63	-.74	-1.65	-.81	.83	-.11	.00	-.44
64	-.74	-1.97	-1.05	1.00	-.48	.16	-.44

Tables D.6 - D.10 Correlation bias estimates using DA 9/18/01 sex ratios

Table D.6 Blacks, age 18 – 29

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-6.91	-.64	-4.44	-2.37	-5.28	-8.56	-6.91
42	-6.91	-8.30	-5.88	-15.94	-1.88	-7.96	-6.91
43	-6.91	-6.62	-5.50	-3.79	-2.57	-6.54	-6.91
44	-6.91	-1.80	-8.23	-13.16	-16.30	-10.05	-6.91
45	-6.91	-11.11	-7.79	-10.37	-4.39	-5.69	-6.91
46	-6.91	-4.43	-9.11	-.17	-17.90	-6.79	-6.91
47	-6.91	-8.07	-7.55	-5.82	-6.99	-6.28	-6.91
48	-6.91	-4.17	-6.83	.48	-8.50	-6.77	-6.91

Table D.7 Blacks, age 30 – 49

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-8.26	-3.00	-6.02	-3.65	-5.84	-9.03	-8.26
42	-8.26	-12.50	-9.19	-17.25	-7.11	-8.19	-8.26
43	-8.26	-5.59	-5.30	-3.40	-3.38	-8.42	-8.26
44	-8.26	.00	-7.41	.00	-10.09	-9.25	-8.26
45	-8.26	-13.80	-9.88	-15.66	-8.06	-7.64	-8.26
46	-8.26	-8.04	-11.60	-4.25	-18.01	-7.92	-8.26
47	-8.26	-9.12	-9.36	-3.20	-9.83	-7.53	-8.26
48	-8.26	-7.27	-9.80	-.37	-12.28	-7.67	-8.26

Table D.8 Blacks, age 50+

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
41	-4.95	-2.12	-3.29	-1.67	-2.84	-5.24	-4.95
42	-4.95	-4.88	-4.67	-3.33	-3.90	-4.83	-4.95
43	-4.95	-5.43	-4.08	-4.83	-2.68	-4.87	-4.95
44	-4.95	.00	-3.16	.00	-3.46	-5.48	-4.95
45	-4.95	-9.58	-6.77	-14.54	-5.98	-4.92	-4.95
46	-4.95	-4.58	-8.61	1.11	-14.06	-4.43	-4.95
47	-4.95	-9.21	-7.49	-8.55	-8.05	-4.38	-4.95
48	-4.95	-8.00	-8.41	-.64	-11.51	-3.84	-4.95

Table D.9 Nonblacks, age 30 – 49

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
1	-.85	.00	-.52	.00	-.50	-1.14	.46
2	-.85	.00	-.36	.00	-.28	-1.14	.46
3	-.85	-.16	-.50	.11	-.35	-1.04	.46
4	-.85	.00	-.52	.00	-.49	-1.14	.46
5	-.85	-.66	-.56	.30	-.06	-.74	.46
6	-.85	-1.56	-.59	-3.16	.61	-.92	.46
7	-.85	-3.01	-.84	-5.18	1.35	-.49	.46
8	-.85	-.80	-.86	.53	-.56	-.62	.46
9	-.85	-.20	-.39	-.59	-.16	-1.15	.46
10	-.85	.00	-.30	.00	-.20	-1.14	.46
11	-.85	.00	-.50	.00	-.47	-1.14	.46
12	-.85	.00	-.46	.00	-.41	-1.14	.46
13	-.85	.00	-.27	.00	-.18	-1.14	.46
14	-.85	-1.31	-.63	-2.60	.34	-.95	.46
15	-.85	-1.44	-.77	-3.59	.19	-1.06	.46
16	-.85	-2.83	-1.27	.43	-.03	.49	.46
17	-.85	-.86	-.52	-.71	.15	-.83	.46
18	-.85	-.11	-.39	.07	-.22	-1.07	.46
19	-.85	-.05	-.53	.03	-.48	-1.11	.46
20	-.85	-1.05	-.52	.31	.31	-.52	.46
21	-.85	.00	-.65	.00	-.72	-1.14	.46
22	-.85	.00	-1.13	.00	-2.08	-1.14	.46
23	-.85	-.95	-.92	-.56	-.60	-.75	.46
24	-.85	-2.83	-1.06	-5.86	.66	-.72	.46
25	-.85	-1.01	-.63	-2.48	.11	-1.09	.46
26	-.85	-.53	-.33	-.68	.14	-1.00	.46
27	-.85	-1.29	-.67	-.91	.26	-.63	.46
28	-.85	.00	-1.15	.00	-2.12	-1.14	.46
29	-.85	.00	-.55	.00	-.55	-1.14	.46
30	-.85	-1.34	-.62	.90	.38	-.25	.46
31	-.85	-.71	-.92	.47	-.78	-.68	.46
32	-.85	-4.19	-1.36	-2.77	.95	.67	.46
33	-.85	-.19	-1.17	-.45	-2.05	-1.13	.46
34	-.85	-2.35	-1.77	-3.14	-2.97	-.47	.46
35	-.85	-1.01	-1.08	-1.27	-1.02	-.85	.46
36	-.85	-2.92	-1.65	-.30	-1.69	.41	.46
37	-.85	-1.24	-1.20	-1.94	-1.24	-.85	.46
38	-.85	.00	-1.67	.00	-4.74	-1.14	.46
39	-.85	-.96	-1.25	-1.07	-1.69	-.84	.46
40	-.85	-.40	-1.67	.26	-4.33	-.88	.46
49	-.85	-.55	-.77	.07	-.56	-.84	-8.26
50	-.85	-1.97	-1.18	-.29	-.51	-.14	-8.26
51	-.85	-1.76	-.88	-2.94	.19	-.76	-8.26
52	-.85	-3.05	-.85	-6.88	1.37	-.80	-8.26
53	-.85	-2.87	-1.52	-.48	-1.04	.34	-8.26
54	-.85	.00	-2.07	.00	-7.79	-1.14	-8.26
55	-.85	-3.91	-1.87	-5.94	-1.95	-.11	-8.26
56	-.85	-3.63	-2.88	2.55	-13.15	1.37	-8.26
57	-.85	-1.14	-1.71	-.86	-3.84	-.70	.46
58	-.85	-.92	-1.44	-5.66	-2.59	-1.75	.46
59	-.85	-.43	-.77	-1.14	-.65	-1.13	.46
60	-.85	-1.52	-1.40	-4.27	-1.81	-1.15	.46
61	-.85	-6.07	-1.49	-14.76	2.38	-.48	.46
62	-.85	-4.02	-1.30	-8.74	1.02	-.58	.46
63	-.85	-2.14	-.80	-12.02	.69	-2.32	.46
64	-.85	-4.37	-1.49	-7.66	.60	-.16	.46

Table D.10 Nonblacks, age 30 – 49

Post-stratum	Two-group	FOR	FRR	MF22	BRE	Das Gupta	Mod 2-group
1	-.79	.00	-.52	.00	-.57	-.88	-.46
2	-.79	-.40	-.32	-.22	-.08	-.79	-.46
3	-.79	-.59	-.60	-.19	-.37	-.72	-.46
4	-.79	.00	-.47	-.02	-.50	-.89	-.46
5	-.79	-1.21	-1.08	-1.60	-1.01	-.83	-.46
6	-.79	-2.19	-.74	-2.36	.32	-.65	-.46
7	-.79	-2.51	-.71	-2.94	.57	-.67	-.46
8	-.79	-1.12	-1.08	.53	-1.06	-.35	-.46
9	-.79	-.97	-.46	-1.19	.05	-.82	-.46
10	-.79	.00	-.30	-.06	-.27	-.89	-.46
11	-.79	-.24	-.64	.11	-.64	-.77	-.46
12	-.79	.00	-.48	.00	-.51	-.88	-.46
13	-.79	.00	-.35	.00	-.33	-.88	-.46
14	-.79	-.77	-.56	-1.03	-.20	-.85	-.46
15	-.79	-2.80	-.91	-1.74	.39	-.28	-.46
16	-.79	-3.28	-1.00	-2.58	.50	-.29	-.46
17	-.79	-.89	-.41	-1.99	.07	-1.04	-.46
18	-.79	-.24	-.42	-.48	-.30	-.91	-.46
19	-.79	.00	-.53	.00	-.59	-.88	-.46
20	-.79	-.27	-.41	-.52	-.27	-.91	-.46
21	-.79	.00	-.82	.00	-1.11	-.88	-.46
22	-.79	.00	-.83	.00	-1.14	-.88	-.46
23	-.79	.00	-.88	.00	-1.25	-.88	-.46
24	-.79	-1.16	-.74	-.35	-.28	-.55	-.46
25	-.79	-.26	-1.06	.12	-1.52	-.76	-.46
26	-.79	-1.07	-.56	-1.36	-.03	-.83	-.46
27	-.79	-.93	-1.00	-1.39	-.97	-.88	-.46
28	-.79	.00	-1.24	.00	-2.19	-.88	-.46
29	-.79	-.61	-1.29	.29	-1.97	-.59	-.46
30	-.79	-1.36	-.78	-.54	-.24	-.53	-.46
31	-.79	-1.11	-.81	-.93	-.46	-.71	-.46
32	-.79	-1.87	-1.37	-3.32	-1.40	-1.01	-.46
33	-.79	-.10	-1.21	-1.82	-2.05	-1.28	-.46
34	-.79	-3.37	-1.51	-4.95	-.86	-.82	-.46
35	-.79	-.28	-1.09	-1.23	-1.59	-1.08	-.46
36	-.79	-4.93	-2.22	-4.06	-2.83	.01	-.46
37	-.79	-1.45	-1.18	-.39	-1.11	-.46	-.46
38	-.79	-.23	-1.88	-.25	-4.62	-.86	-.46
39	-.79	.00	-1.51	.00	-3.13	-.88	-.46
40	-.79	-1.72	-2.15	-.19	-5.01	-.31	-.46
49	-.79	-.99	-.69	-1.10	-.28	-.79	-4.95
50	-.79	-3.81	-1.18	-2.42	.42	-.05	-4.95
51	-.79	-.58	-.71	-.94	-.56	-.90	-4.95
52	-.79	-1.73	-.96	-2.67	-.39	-.90	-4.95
53	-.79	-3.33	-1.60	-1.47	-1.19	-.01	-4.95
54	-.79	.00	-2.44	.00	-8.21	-.88	-4.95
55	-.79	-.37	-2.27	-1.80	-6.76	-1.18	-4.95
56	-.79	-5.05	-3.62	2.55	-15.91	1.64	-4.95
57	-.79	-1.60	-2.15	-.55	-5.08	-.44	-.46
58	-.79	-1.29	-1.82	-4.48	-3.58	-1.49	-.46
59	-.79	-1.39	-.91	-.92	-.48	-.60	-.46
60	-.79	-2.65	-1.46	-3.92	-1.18	-.85	-.46
61	-.79	-8.16	-2.06	-6.90	.67	.71	-.46
62	-.79	-5.98	-1.46	-21.63	1.17	-3.77	-.46
63	-.79	-1.75	-.86	.83	-.16	-.05	-.46
64	-.79	-2.09	-1.12	1.00	-.54	.11	-.46

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